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09/469,652 12/22/99 WIERER

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EXAMINER

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ART UNIT

PAPER NUMBER

2815

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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

| | | |
|------------------------------|--------------------------|------------------|
| Office Action Summary | Application No. | Applicant(s) |
| | 09/469,652 | WIERER ET AL. |
| | Examiner Chris C. Chu | Art Unit 2815 |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) Responsive to communication(s) filed on ____.

2a) This action is **FINAL**. 2b) This action is non-final.

3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) Claim(s) 1 - 18 is/are pending in the application.

4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5) Claim(s) ____ is/are allowed.

6) Claim(s) 1 - 18 is/are rejected.

7) Claim(s) ____ is/are objected to.

8) Claims ____ are subject to restriction and/or election requirement.

Application Papers

9) The specification is objected to by the Examiner.

10) The drawing(s) filed on 22 December 1999 is/are objected to by the Examiner.

11) The proposed drawing correction filed on ____ is: a) approved b) disapproved.

12) The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) All b) Some * c) None of:

- Certified copies of the priority documents have been received.
- Certified copies of the priority documents have been received in Application No. ____.
- Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14) Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) Notice of References Cited (PTO-892) 18) Interview Summary (PTO-413) Paper No(s). ____.

16) Notice of Draftsperson's Patent Drawing Review (PTO-948) 19) Notice of Informal Patent Application (PTO-152)

17) Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ 20) Other: _____

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character "22A" in Figure 3 has been used to designate both "ohmic" and "contact" on page 9, line 1 and on same page, line 3 of the specification. Also, reference character "41" in Figure 6 has been used to designate both "the substrate" and "a sapphire substrate" on page 10, line 5 and on same page, line 13 of the specification. Correction is required.

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: reference character hu in Figures 1, 3, 5, and 6, and reference character 21 in Figure 3 are not described in the specification.
Correction is required.

3. The drawings are objected to because "Figure 3" should be --Figure 4-- and "Figure 4" should be --Figure 3--. Because the drawings in the figures and descriptions in the specification are not match each other. Correction is required.

4. Applicant is required to submit a proposed drawing correction in reply to this Office action. However, formal correction of the noted defect can be deferred until the application is allowed by the examiner.

Specification

5. The disclosure is objected to because of the following informalities: on page 6, line 11, “(linear I-V)” is missing some simple description about I and V, and their relationship to each other. On page 9, line 12, “current LED structure” is not clear. The word “current” is indicating the invention of this application or a current existing LED structure in the market. On page 6, line 7, “the semiconductor structure” should be --a semiconductor structure--. On page 7, line 30, “contacts..” should be --contacts--. On page 9, line 1, “the ohmic 22A and reflector layers 22C” should be --the ohmic layer 22A and the reflector layer 22C--, etc. The specification is replete with such errors on pages 8, 9, and 10 of the specification, and each of them should be corrected.

Appropriate correction is required.

Claim Objections

6. Claims 1, 8 and 11 are objected to because of the following informalities: in claim 1, line 2 and claim 11, line 2, “at least one p and” should be --at least one p-type and-- and in claim 11, line 2, is missing a word --and-- after the semicolon. In claim 8, line 1, “wherein the” should be --wherein the--. Appropriate correction is required.

Claim Rejections - 35 USC § 102

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1, 4, 7, 8, 11, 14, and 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Schetzina.

Fig. 27 of Schetzina shows a “light emitting device” (120) comprising a “heterostructure” (11) of semiconductor materials having at least one p-type layer (17) and one n-type layer (16), and the p-type layer (17) and the n-type layer (16) have p and n contacts. The p contact is electrically connected to the p-type layer and the n contact is electrically connected to the n-type layer, wherein one of the p and n contacts is a multi-layer contact having at least one ohmic layer (102 for n-type contact layer and 19 for p-type contact layer) and one reflector layer (13 and column 21, lines 14 - 19).

Regarding claims 4 and 14, Schetzina discloses the multi-layer contact has a barrier layer (18 in Fig. 27) interposing the ohmic contact layer and the reflector layer.

Regarding claims 7 and 17, Schetzina discloses the reflector layer is selected from a group that includes Al, Cu, Rh, Pd, and Au (column 18, lines 48 – 50).

Regarding claim 8, in Fig. 27, reference character (102) and reference character (19) clearly show that the p and n contacts are on opposing faces of the heterostructure.

Regarding claim 11, Fig. 27 of Schetzina shows a “light emitting device” (120) comprising a “GaN-based heterostructure” (11 and column 22, lines 26 – 30 (Group III-V materials includes Ga and blue light is indicating N)) of semiconductor materials having at least one p-type layer (17) and one n-type layer (16), and the p-type layer (17) and the n-type layer (16) have p and n contacts. The p contact is electrically connected to the p-type layer and the n contact is electrically connected to the n-type layer, wherein one of the p and n contacts is a

multi-layer contact having at least one ohmic layer (102 for n-type contact layer and 19 for p-type contact layer) and one reflector layer (13 and column 21, lines 14 - 19).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 2 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina in view of Tischler.

Schetzina discloses the claimed invention except the reflectivity of the multi-layer contact of the light-emitting device, which is greater than 75 %. However, Tischler discloses the reflectivity of the multi-layer contact having a “peak reflectivity [] measured to be 80% at 442nm” (column 11, lines 47 – 52). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to modify Schetzina by increasing the reflectivity of the multi-layer contact to be greater than 75 %. The ordinary artisan would have been motivated to modify Schetzina in the manner described above for at least the purpose of increasing a light output and light extraction efficiency (column 10, lines 46 – 61 and column 4, lines 49 - 54).

10. Claims 3 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina in view of Sugiura et al.

Schetzina discloses the claimed invention except the contact resistance of the multi-layer contact of the light-emitting device, which is less than $0.01 \Omega\text{-cm}^2$. However, Sugiura et al. discloses contact resistance of the multi-layer contact having “about $0.1 \Omega\text{cm}^2$ is reduced to $0.001 \Omega\text{cm}^2$ ” (column 5, lines 27 – 32). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to modify Schetzina by decreasing the contact resistance of the multi-layer contact to be less than $0.01 \Omega\text{-cm}^2$ as taught by Sugiura et al. The ordinary artisan would have been motivated to modify Schetzina in the manner described above for at least the purpose of improving performance of the light-emitting device by decreasing the contact resistance in the multi-layer contact.

11. Claims 5, 10, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina in view of Nakagawa et al.

Regarding claims 5 and 15, Schetzina discloses the claimed invention except the thickness of the reflector layer, which is greater than 500 angstroms. However, Nakagawa et al. discloses the thickness of the reflector layer to be “(Ti/Pd/Ag (400nm/200nm/1 μm thick))” (column 19, lines 45 – 48). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to modify Schetzina by increasing the thickness of the reflector layer to be greater than 500 angstroms. The ordinary artisan would have been motivated to further modify Schetzina in the manner described above for at least the purpose of increasing the reflection and to have a high quality semiconductor layer (column 19, line 57 – 59).

Regarding claim 10, a difference between Schetzina and the claimed invention is that the reflector layer is Ag. However, Nakagawa et al. discloses the reflector layer using a “silver after being burned also function as a back-surface electrode and a back-surface reflection layer” (column 14, lines 1 – 2). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to modify Schetzina by using Ag for the reflector layer as taught by Nakagawa et al. The ordinary artisan would have been motivated to modify Schetzina in the manner described above for at least the purpose of reducing the reflection loss of an incident light (column 14, lines 11 – 12).

12. Claims 6 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina.

Schetzina discloses the claimed invention except for the thickness of the ohmic contact layer, which is less than 200 angstroms. However, he discloses the thickness of the ohmic contact layer to be “about 1000 angstroms” in the specification (column 6, line 13). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the thickness of the ohmic contact layer to be less than 200 angstroms, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. The ordinary artisan would have been motivated to further modify Schetzina in the manner described above for at least the purpose of reducing absorption but being thick enough to keep the specific contact resistance below $10^{-2} \Omega\text{-cm}$. In re King, 231 USPQ 136, (Fed. Cir. 1986).

13. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina in view of Yoshida et al.

Schetzina discloses the claimed invention except the ohmic contact layer includes Ni and Ag. However, Yoshida et al. discloses the ohmic contact layer including Ni and Ag (column 22, lines 61 – 65). Therefore, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Schetzina by including Ni and Ag for the ohmic contact layer as taught by Yoshida et al. The ordinary artisan would have been motivated to further modify Schetzina in the manner described above for at least the purpose of reducing “the contact resistance by about 10% between the contact layer” (column 15, lines 9 – 11).

14. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina in view of Okazaki.

Schetzina discloses the claimed invention except the ohmic contact layer, which is selected from a group that consist of Ti, Au/NiO, and Ni/Au. However, Okazaki discloses that the material of the ohmic contact layer (13) is selected from a group of “titanium (Ti), nickel (Ni), etc.” (column 8, lines 9 – 14 and column 8, lines 32 – 37). Therefore, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to modify Schetzina by selecting from a group that consist of Ti, Au/NiO, and Ni/Au for the ohmic contact layer as taught by Okazaki. The ordinary artisan would have been motivated to modify Schetzina in the manner described above for at least the purpose of decreasing the ohmic contact resistance between the layers and increasing the reflectivity of the ohmic contact layer.

Conclusion

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Nakamura et al. and Tajiri disclose the light-emitting device that is having a heterostructure of semiconductor materials.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is (703) 305-6194. The examiner can normally be reached on M-F (8:30 - 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on (703) 308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7382 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Chris C. Chu
Examiner
Art Unit 2815

c.c.
March 15, 2001



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